PROGRESS REPORT

TITLE

Mute swan distributions and their impacts on submerged aquatic vegetation, Eastern Population tundra swans, and other waterbirds in the Chesapeake Bay area of Maryland

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INTRODUCTION

Native to Eurasia, mute swans (*Cygnus olor*) were introduced to the United States (U.S.) as ornamental additions to estates, local parks and zoos in the late 1800's. By the early 1900's, mute swans were found throughout much of the northeastern U.S. In 1966, mute swan numbers recorded during Midwinter Waterfowl Surveys (MWS) conducted by the US Fish and Wildlife Service (USFWS) were estimated at 2,100 swans. Currently, the US mute swan population is estimated at 21,400 swans; 14,300 are in the Atlantic Flyway.

The largest group of mute swans in the U.S. is found in the Chesapeake Bay region of Maryland. Mute swans occurring in this area are attributed to 5 swans that escaped captivity in 1962 (Reese 1980). The mute swan population in Maryland has since increased exponentially and peaked at 3,900 individuals. As a result of a rigorous egg-addling program, the population of mute swans in Maryland has stabilized at 3,600 birds.

Submerged aquatic vegetation (SAV) is the primary food source for mute swans and important to the Bay because it provides food and habitat for many species, stabilizes the shoreline, and acts as a nutrient buffer (Thayer et al. 1975). Feeding studies have found that mute swans consume upwards of 4.0 kg of SAV a day (Mathiasson 1973, Willey 1968). Large aggregations of swans have also been shown to severely reduce and even eliminate beds of SAV (Mathaisson 1973). The year-round feeding by non-indigenous mute swans on SAV beds could significantly impact the Bay ecosystem.

Mute swans may also negatively affect native Eastern Population (EP) tundra swans (*C. columbianus columbianus*) wintering in Maryland. In addition to overgrazing traditional wintering areas used by tundra swans, mute swans can directly impact tundra swans through aggressive encounters. Mute swans are aggressive toward conspecifics and other species, and there have been reports of mute swans killing other waterfowl and displacing or destroying nests of breeding birds (Willey 1968 in Allin et al. 1987). Mute swans also exhibit stronger, more aggressive attacks toward white objects, including other swans (Norman 1977).

Historically, >50% of the EP tundra swans wintered in the Chesapeake Bay (Stewart and Manning 1953). However, numbers of tundra swans have been declining in Maryland since the 1960's (Serie et al. 2002). Currently, only 20% use the Bay (Serie et al. 2002). The reasons for this decline and the relationships between mute and tundra swans are not well documented.

Previous studies have identified the need to evaluate the ecological impact of mute swans on SAV and native waterfowl (Reese 1975, Allin et al. 1987). To date, little is known about the

impacts that mute swans are having on the Bay ecosystem. This study will provide information about mute swan seasonal movements, the historical abundance and distribution of mute swans in relation to SAV and EP tundra swans, and the impacts that these birds might have on the Bay community.

OBJECTIVES

1. Document seasonal movements of mute swans in the Chesapeake Bay,
2. Document preference and use of SAV beds by mute swans,
3. Describe the distribution of both mute swans and tundra swans in relation to SAV,
4. Quantify aggressive interactions between mute and tundra swans in winter flocks.

METHODS

2002-2003 Field Season

In 2002, a pilot study was initiated. Data were collected to provide baseline information about mute swan movements in the Chesapeake Bay area of Maryland. The study area included 3 counties in Maryland: Talbot, Queen Anne's and Dorchester (Figure 1).

Movements

We monitored the seasonal movements of breeding birds with very high frequency (vhf) radio-transmitters manufactured by Advanced Telemetry Systems (ATS) (Isanti, Minnesota) and Holohil Systems Limited (Carp, Ontario, Canada). Radio-transmitters had a life expectancy of 14 months. We captured 6 swans (n = 2 males and 4 females) during the nesting period in April and instrumented them with radio-transmitters and USFWS aluminum tarsus bands. The eggs in the nests of the 6 marked individuals were addled.

We located marked swans once a month from August until present. We collected locations by homing in on marked individuals until they could be seen. Signals from birds that could not be seen from shore were triangulated to estimate their location. We recorded the social status of the bird (whether the bird was alone, paired, or flocked) at each location.

In addition, we captured 2 males from distinct molting flocks in August. We attached satellite transmitters containing a global positioning system (GPS) (Microwave Telemetry, Inc., Columbia, Maryland) to these birds by using a backpack harness made with Teflon ribbon. The duty cycle for GPS satellite-transmitters was 1 GPS location per hour for 9 months. GPS locations were

downloaded by satellite every 3 days and transmitted to the Argos Satellite Location and Data Collection System (Landover, Maryland). We selected males because they are typically larger and heavier than females (Ciaranca et al. 1997) and can better handle the weight of the transmitter. We also marked these 2 individuals with uniquely coded neck collars (white with black text) and with USFWS aluminum tarsus bands. We attempted to observe birds with GPS satellite-transmitters to determine whether they remained flocked throughout the winter and to estimate flock size.

GPS satellite-transmitter #33898 failed after approximately 1 month. We recovered the transmitter and sent it back to the manufacturer for repair. We attached transmitter #33898 to another male from the same flock in September 2002. Swan #33897 was found dead in February 2003, and #33898 was found dead in January 2003. We did not attach the GPS satellite-transmitters to other birds due to inclement weather.

Aggression

We conducted surveys during the winter to record any aggressive interactions between mute swans and EP tundra swans or other birds. We observed flocks of swans through a spotting scope during 10-30 minute observation periods conducted throughout the study area. We surveyed once or twice a month from 8 January until 8 March 2003. Before the survey began, we recorded the number of adults and cygnets of both mute and EP tundra swans, and we identified any neck collars or transmitters. We also recorded the spatial distribution of the 2 species within the flock, flock cohesiveness, and proximity of the nearest mute and tundra swans (see Appendix 1 for the datasheet and survey instructions). For each interaction, we documented the species involved, the level of aggression (threat or attack), the duration of the interaction, and the cause of the interaction, if known.

2003-2004 Field Season

Movements

During April and May 2003, we marked 23 females and 3 males from breeding pairs with USFWS tarsus bands. Females were also fitted with ATS vhf radio-transmitters that were mounted on neck collars. Marked females were classified as either birds with young (BWY; n = 14) or birds without young (BWOY; n = 9). We marked the mates to 3 of the radioed females (BWY= 1, BWOY= 2) with alphanumeric neck collars (white with black text) to observe the retention of pair bonds. Most of the BWOY were birds with addled eggs. However, 4 of the females originally

classified as BWY lost their young or their nests were destroyed. We reclassified these birds as BWOY. Birds marked with vhf radio-transmitters are being located once every 7-10 days during the 2003-2004 field season.

Aggression

We used a motorized pair of floating tundra swan or Canada goose (*Branta canadensis*) decoys to elicit aggressive responses in mute swans during the nesting season. We chose paired individuals marked with radio-transmitters or pairs that were found while looking for radio-transmitters. Before the survey began, we determined whether both members of the pair were present and noted whether the pair had cygnets. During each 10-minute survey, we launched the decoys and moved them toward the pair. We recorded the time and estimated the distance from the decoys to the pair 3 times during the survey: 1) when the decoys enter the water, 2) when the pair first notices the decoys, and 3) when the first aggressive response occurs. We categorized all behaviors during the survey, and we filmed most of the surveys for further analysis.

PRELIMINARY RESULTS

Movements

Data were used from 5 of the 6 birds with vhf radio-transmitters marked during the 2002-2003 field season. One of the marked birds (#951) destroyed the transmitter shortly after banding. The number of monthly locations per bird ranged from 7-11 for the year (Figure 2). The average straight-line distance between monthly locations was 4.7 km (SD = 1.7) (Table 1). These swans moved more than expected during the 2002-2003 field season. All left their territories during the winter months and those that survived the winter, returned to their territories for the breeding season.

GPS satellite-transmitter locations were gathered for 1-7 months (Table 2). We had assumed that birds not defending territories would move more than swans that defended territories; however, the swans with a GPS transmitter moved less than expected during the 2002-2003 field season. We also assumed that the marked birds would be associated with SAV. The locations for the swans with GPS satellite-transmitters were overlaid with SAV, and the swans do appear associated with SAV (Figures 3 and 4).

Aggression

We observed aggressive encounters during 4 of the 19 surveys conducted to quantify aggression. Two encounters involved adult mute swans striking young mute swans. During 1 survey that lasted for 28 minutes, multiple strikes were recorded (tundra swan cygnet at tundra swan adult, mute swan adult at tundra swan adult, tundra swan cygnet at gull (*Larus* sp.), tundra swan cygnet at mute swan adult). Also during this survey, an adult mute swan chased a northern pintail (*Anas acuta*) over a short distance, but did not strike. The most aggressive encounter we observed lasted over 2 minutes, where a mute swan bit and held on to a tundra swan, causing the tundra swan to leave the area.

FUTURE PLANS

Field Work

This summer we marked 7 BWY females with radio-transmitters and 2 BWY mates to radioed females with alphanumeric neck collars during the molt in August when the birds were flightless. Also during the molt, we attached 10 radio-transmitters to birds in molting flocks. We marked 4 males from distinct molting flocks with GPS satellite-transmitters. We marked an additional 80 birds from molting flocks with alphanumeric neck collars. Neck collars will be identified and recorded while tracking vhf radio-transmitters. We will also ask local bird watchers to report neck collars on a website maintained by the Maryland Department of Natural Resources.

We will conduct surveys to quantify aggression with the motorized decoys from November 2003 until February 2004 when EP tundra swans are wintering in the Chesapeake Bay. In January, we will visit 30 territorial pairs 3 times, each time with a different pair of decoys (mute swans, tundra swans, or Canada geese). We display the decoys to each pair for 10 minutes and record their response. We will randomize the order that the decoys will be offered and will wait approximately 1 week between surveys. We will record all surveys with a video camera for further analysis. We will also conduct additional surveys with the decoys and behavioral surveys with pairs and flocks year-round to determine a relative level of aggression throughout the seasons.

Analyses

We will study movement data collected from 2002 to 2004, MWS and Midsummer Mute Swan Surveys (MSMSS) to look at mute swan distributions within the Bay, including habitat availability, and habitat use. We will use GIS software to overlay radio and GPS satellite-transmitter locations with SAV data to determine seasonal habitat use and to identify preferred SAV beds. The

information we collect regarding the social status (alone, paired or flocked) of the radio-marked birds will be used to determine the number of birds in SAV beds at a particular time. We will analyze MWS data to track changes through time of the number of mute swans, tundra swans and the amount of SAV in each MWS segment. We will use MSMSS data to describe areas of use in August and early September by molting flocks and family groups.

REPORT SCHEDULE

The 2002-2003 pilot study was invaluable for determining methods for the 2003-2004 field season. We will record more locations for the vhf radio-transmitter birds and place greater emphasis on aggression surveys and the experiment with the decoys. The 2003-2004 field season will conclude February 2004. Anticipated completion date for the Master of Science thesis is August 2004. Before the thesis is complete, an additional progress report will be produced during the spring of 2004.

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Table 1. Distance between locations from mute swans marked in 2002 with vhf radio-transmitters in the Chesapeake Bay area of Maryland. Total distance was calculated by measuring the straight-line distance between locations.

Bird code[a]	Start date (2002)	Date last recorded (2003)[b]	Number of locations	Distance traveled (km)			
				Total distance	Maximum	Minimum	Mean distance
012 (F)	25 Apr	15 Apr*	8	23.13	7.69	0.16	2.89
032 (F)	26 Apr	15 Apr*	11	66.79	29.01	0.09	6.07
101 (F)	27 Apr	15 Apr*	10	56.76	17.00	0.18	5.68
052 (M)	26 Apr	9 Mar	9	25.64	11.43	0.39	2.85
979 (M)	26 Apr	8 Mar	7	41.94	14.40	0.03	5.99

[a] F = female, M = male
[b] * = currently being tracked

Table 2. Distance between GPS locations from mute swans marked with GPS satellite-transmitters in the Chesapeake Bay area of Maryland. Transmitter #33898 was attached to two different birds; movements from both birds are reported below. Total distance was calculated by measuring the straight-line distance between locations.

Bird code	Start date	Date last recorded	Number of locations	Distance traveled (km)			
				Total distance	Maximum	Minimum	Mean distance
33897	5 Aug 2002	19 Feb 2003	2,628	512.93	20.22	0.02	0.20
33898	6 Aug 2002	6 Sep 2002	59	17.74	1.39	0.02	0.30
33898	17 Sep 2002	16 Jan 2003	1,661	499.19	5.18	0.02	0.30

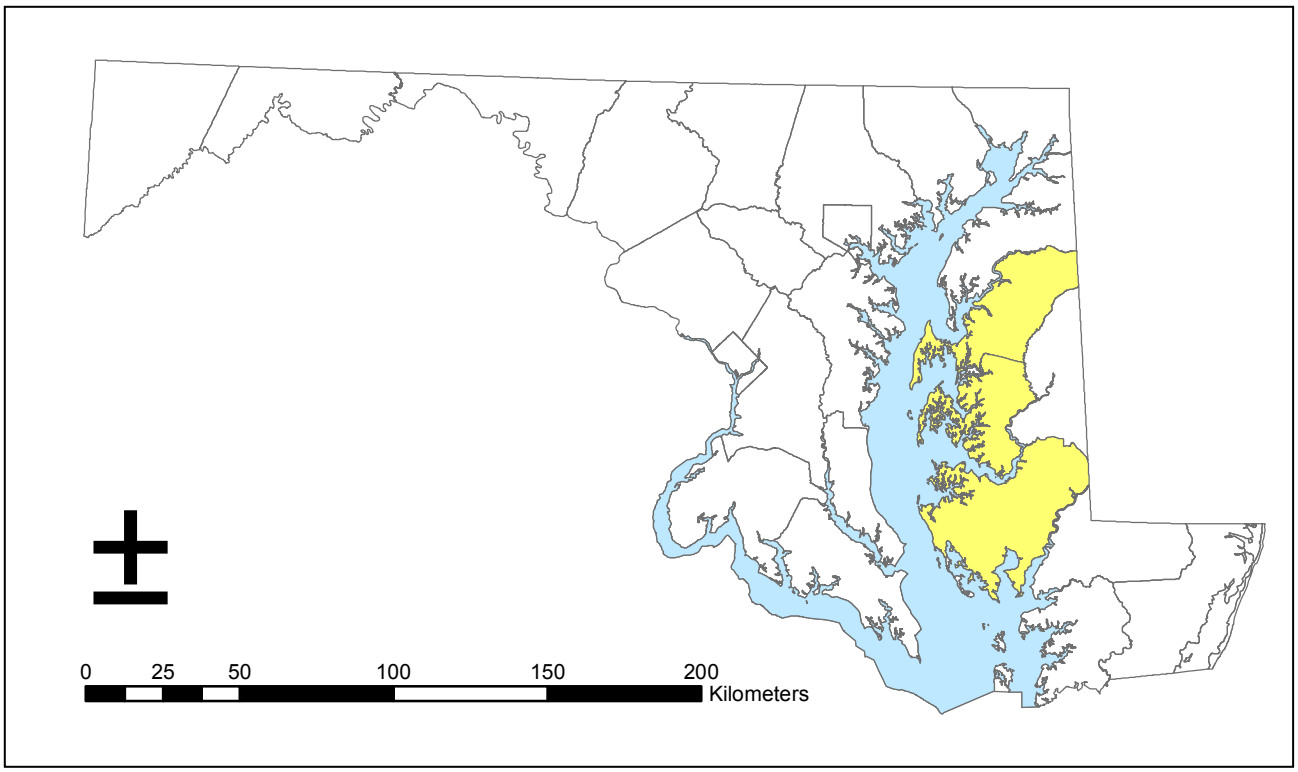


Figure 1. Mute swans were captured, marked and located in three counties in Maryland on the Chesapeake Bay. The three counties in the study area are shaded. From north to south: Queen Anne's, Talbot and Dorchester Counties.

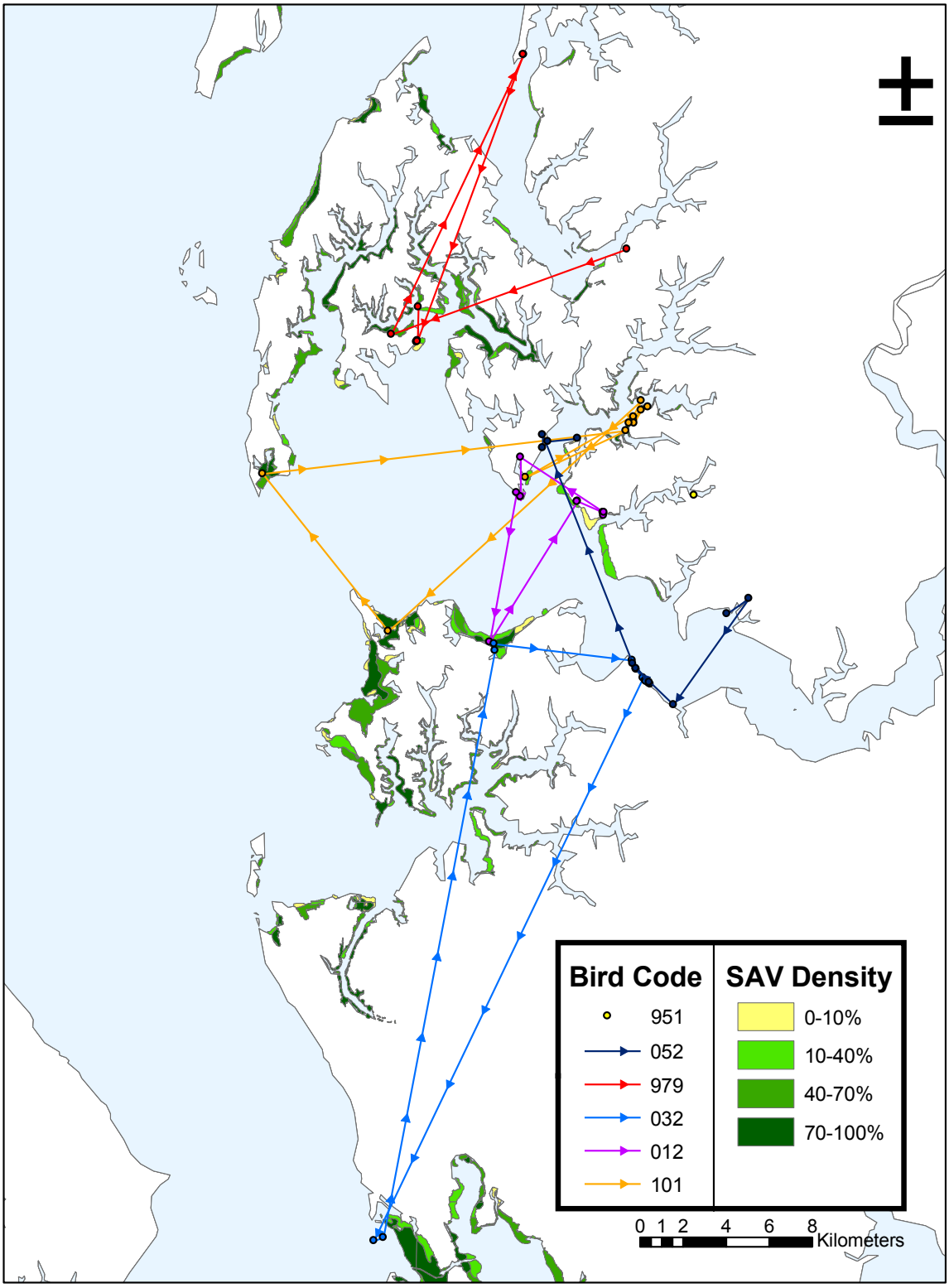


Figure 2. Locations are shown from 6 birds with vhf radio-transmitters on the Chesapeake Bay in Maryland from April 2002 to April 2003. Bird #951 only has one location and is represented by a point. Locations were overlaid with SAV by density class for 2001, because the SAV data from 2002 were not available.

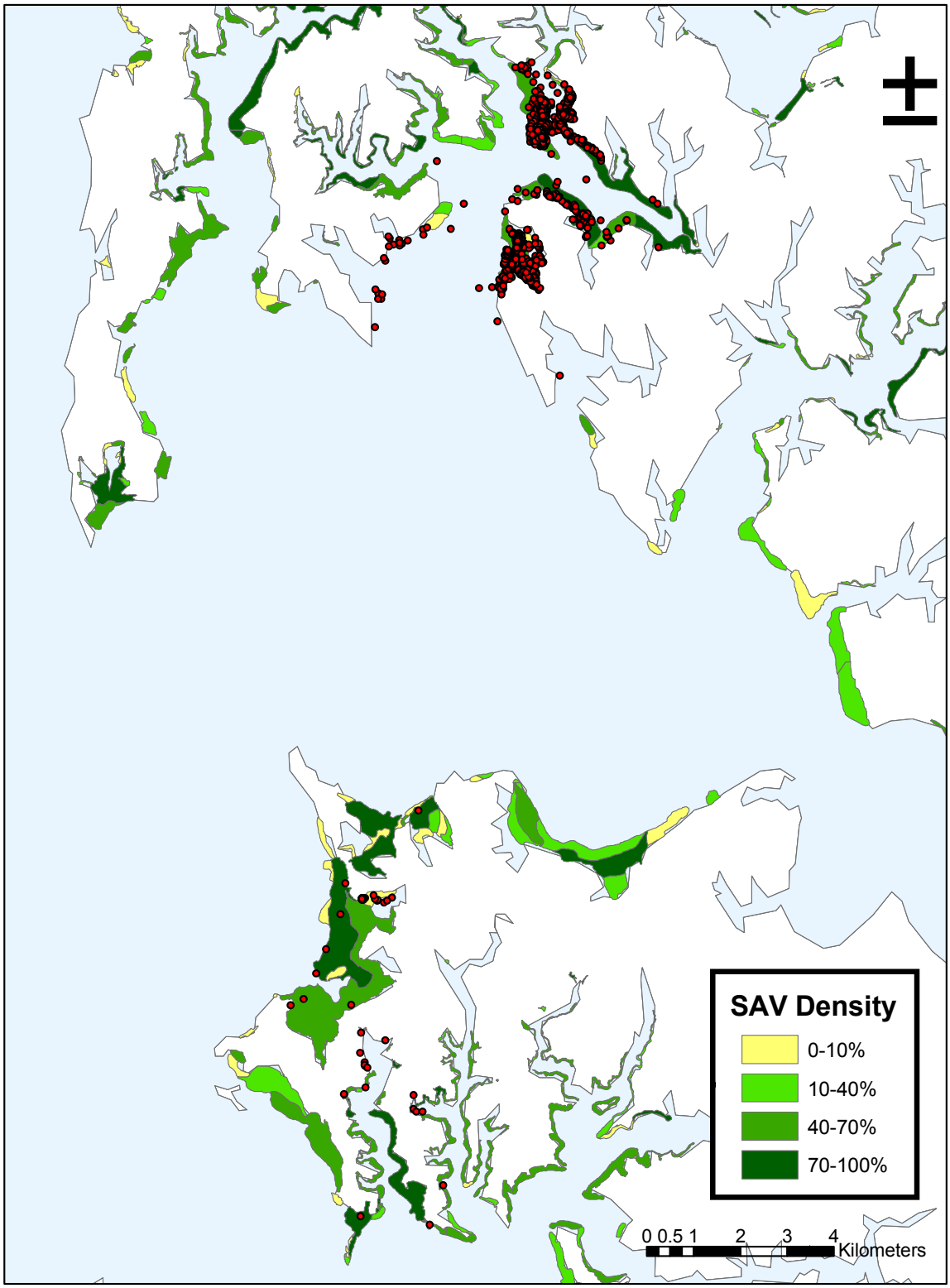


Figure 3. Locations are represented by red points from GPS satellite-transmitter #33897 on the Chesapeake Bay in Maryland from 5 August 2002 until 19 February 2003, with SAV for 2001.

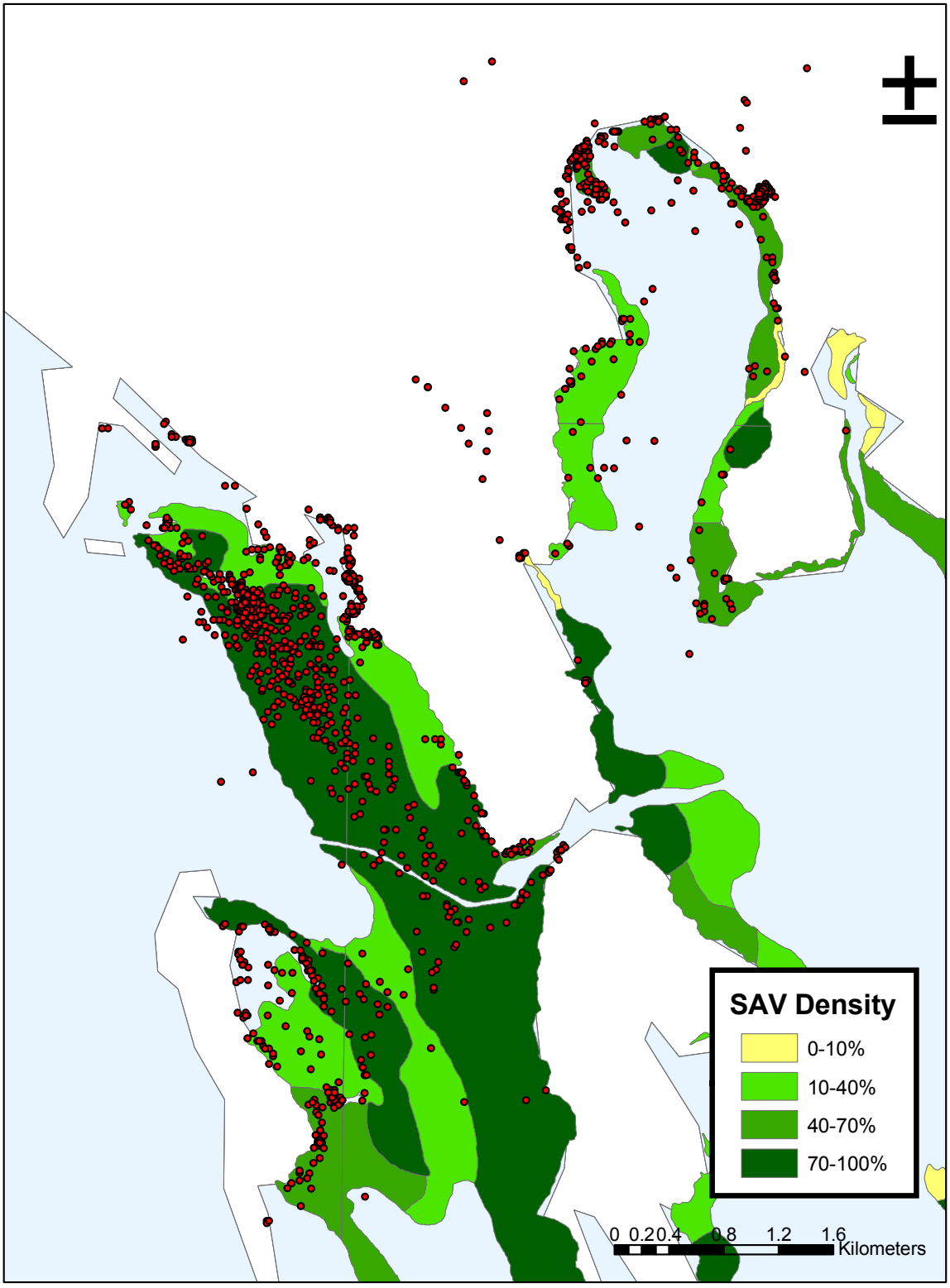


Figure 4. Locations are represented by red points from GPS satellite-transmitter #33897 on the Chesapeake Bay in Maryland from 17 September 2002, until 16 January 2003, with SAV for 2001. Points located inland are on smaller creeks that are not shown on this map.

APPENDIX 1

Date _____/_____/_____ Start Time _____ Stop Time _____

Location _____ State _____ County _____

GPS Lat_____ _____ Long_____ Map attached? Y N

Flock size			
Mute Swans		**Tundra Swans**	
Total # MUSW	# Cygnets	Total # TUSW	# Cygnets

Swan ID's (neckbands and radio transmitters)

___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___

___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___

___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___

___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___

Comments

Flock distribution (circle one)

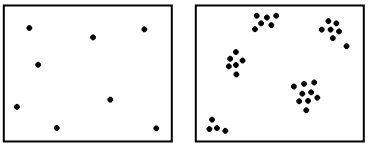
Mixed Separate

Partially mixed

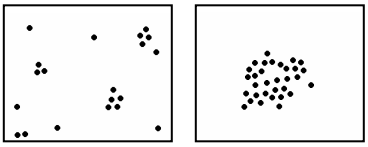
Proximity of MUSW and TUSW

Flock cohesiveness (circle one)

Spread Out Clustered



Mixed Tight



Interaction seen? Y N If YES, please describe below (species involved, level, duration and cause):

Observer

OBSERVERS FIRST INITIAL AND LAST NAME

Ex. **C. Sousa**

Date

MONTH / DAY/ YEAR

Ex. **12/22/02**

Start/Stop Time

24:00 HOURS

Ex. **13:34 for 1:34 PM**

Location

BRIEF DESCRIPTION, INCLUDE WATERWAYS AND ROADS WHEN KNOWN. MORE INFORMATION IS BETTER

Ex. **At the end of Evergreen Rd. on Island Creek, facing east.**

State

TWO LETTER CODE

Ex. **MD**

County

LIST THE COUNTY WHERE THE BIRDS WERE SEEN

Ex. **Talbot**

GPS

DEGREES MINUTES SECONDS

Ex. **Lat 38 42 15 Long 76 15 00**

Map attached? Y N

CIRCLE YES OR NO; IF YES PLEASE STAPLE TO THE DATA SHEET

Flock size

COUNT THE *TOTAL* NUMBER OF BIRDS OF BOTH SPECIES FIRST (include cygnets in this number). PLACE AN 'E' IN THE BOX IF FLOCK SIZE IS ESTIMATED. DETERMINE THE SPECIES AND NUMBER OF CYGNETS; IF THERE ARE CYGNETS BUT THE SPECIES IS UNKNOWN, PLACE THE NUMBER OF UNKNOWN CYNETS IN THE MUTE SWAN # CYGNETS BOX AND CIRCLE IT. See example below.

Flock size			
Mute Swans		**Tundra Swans**	
Total # MUSW	# Cygnets	Total # TUSW	# Cygnets
150 E	6 (2)	42	0

Interpretation
150 MUSW estimated flock size
6 MUSW cygnets and 2 unknown cygnets
42 TUSW exact count
0 TUSW cygnets identified

Flock distribution

ESTIMATE HOW MIXED THE TWO SPECIES OF SWANS (MUSW AND TUSW) ARE DISTRIBUTED; CHOOSE FROM THE OPTIONS BELOW

Mixed – The two species are well mixed, no clear distinction between species

Partially mixed – There is some clustering of species but in general, still mixed

Separate – The two species are distinctly separate

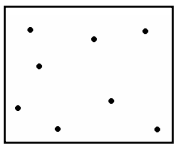
Proximity of MUSW and TUSW

ESTIMATE THE DISTANCE BETWEEN THE CLOSEST MUTE AND TUNDRA SWANS IN FEET; CAN BE LESS THAN 1 FOOT

Flock cohesiveness

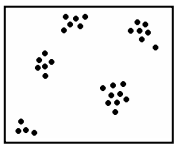
THIS IS FOR MUSW AND TUSW TOGETHER (Do NOT circle if you selected SEPARATE for flock distribution above). CIRCLE ONE OF THE OPTIONS; YOU ONLY NEED TO CIRCLE THE TITLE.

Spread Out



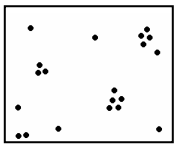
Swans are relatively evenly spaced

Clustered



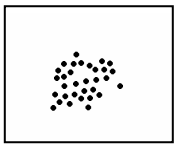
Swans are clustered together

Mixed



Swans are relatively evenly spaced with some clustering

Tight



Swans are clustered together tightly

Swan ID's This includes neckbands and vhf radio-transmitters.

Neckbands

List SPECIES, COLLAR AND TEXT COLORS, AND FOUR CHARACTER ALPHANUMERIC CODE
There are 7 spaces for recording neckband information. The species is entered first (either M or T, see below). The collar color and text color are entered in the next two spaces (see color codes below). The remaining 4 spaces are for the alphanumeric code. Please use capital letters. Do not guess the alphanumeric code, characters that cannot be determined should be recorded as dashes (see examples below). Make note of any unusual neckbands in the comments (odd codes, colors etc.).

SPECIES CODES
M = Mute swan
T = Tundra swan

COLOR CODES

R = Red	L = Blue
O = Orange	K = Black
Y = Yellow	G = Gray
E = Green	W = White

Ex.1 **MWKCA90**
Mute swan, white collar with black text, CA90
Ex.2 **TGKH350**
Tundra swan, gray collar with black text, H350
Ex.3 **TEWS _ 4 _**
Mute swan, red collar with white text, S dash 4 dash, two codes unknown.
Ex4. **M_K _ _ _ _ collar tinted orange, unable to read**
Mute swan, uncertain of collar color, black text, unable to determine alphanumeric code.

Vhf radio-transmitters

List FREQUENCY
Record the 6-digit frequency in the spaces provided. Leave the last space blank.
Ex. **151.064**

Comments

PLEASE PROVIDE ANY ADDITIONAL COMMENTS; USE THE BACK OF THE DATA SHEET IF MORE SPACE IS REQUIRED. MAKE ANY NOTES ABOUT FREQUENCY CHANGES OR INCONSISTENCIES. NOTES ABOUT THE TRANSMITTER BIRD SHOULD INCLUDE: WHETHER THE BIRDS WAS SEEN, AND THE STATUS (PAIRED, FLOCKED, LONE).

Interaction seen? Y N CIRCLE YES OR NO

NO would imply no interaction, that the two species of swans are loafing, feeding or preening together

If **YES**, please describe the interaction. I am specifically looking at mute swan aggression toward other waterfowl but any aggression by mute swans (towards people etc.) should be recorded.

1. LIST THE SPECIES AND NUMBER OF EACH SPECIES INVOLVED IN THE INTERACTION
2. DESCRIBE THE LEVEL OF AGGRESSIVENESS AND THE AGGRESSIVE BEHAVIORS OR POSTURES
3. DURATION OF THE INTERACTION
4. LIST WHAT CAUSED THE AGGRESSION, IF KNOWN

Species codes	
MUSW = Mute swan	ABDU = American black duck
TUSW = Tundra swan	MALL = Mallard
CAGO = Canada goose	WODU = Wood duck
SNGO = Snow goose	Others = (Write in)

Level **Aggression** – Behaviors include strikes and attempted strikes
Threat – Behaviors and postures include raised neck feathers, wing flapping, busking, foot clapping, and rotation displays

Raised neck feathers – Usually is followed by other behaviors.
Wing flapping – Spread of wings without waving (Johnsgard 1965)
Busking – Performed by both sexes. Includes raising secondaries into arched position over back and raising neck feathers. Occurs at varying levels and intensifies as neck is drawn back. Most intense busk includes swimming with both feet together causing a lurching motion (Ciaranca et al., 1997)
Foot clapping - Used for territorial advertisement. Includes loud slapping of feet on the water as they land; typically will hold head and neck lower than normal in flight (Marshall 1984, Lumsden 1985).
Rotation displays – Non-violent advertisement display that usually takes place on the boundary of a territory. Typically two male mute swans will busk and swim towards each other. They will then rotate on the spot; usually the birds are very close (less than 1 m). They will rotate almost synchronously (Lind 1984).

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